

Quiz Next Class 2-d Momentum

Today: Electrostatics

There is a quantity called charge, q or Q .

units: Coulomb, C

The charge of an electron or proton (or e) is $1.602 \times 10^{-19} \text{C}$

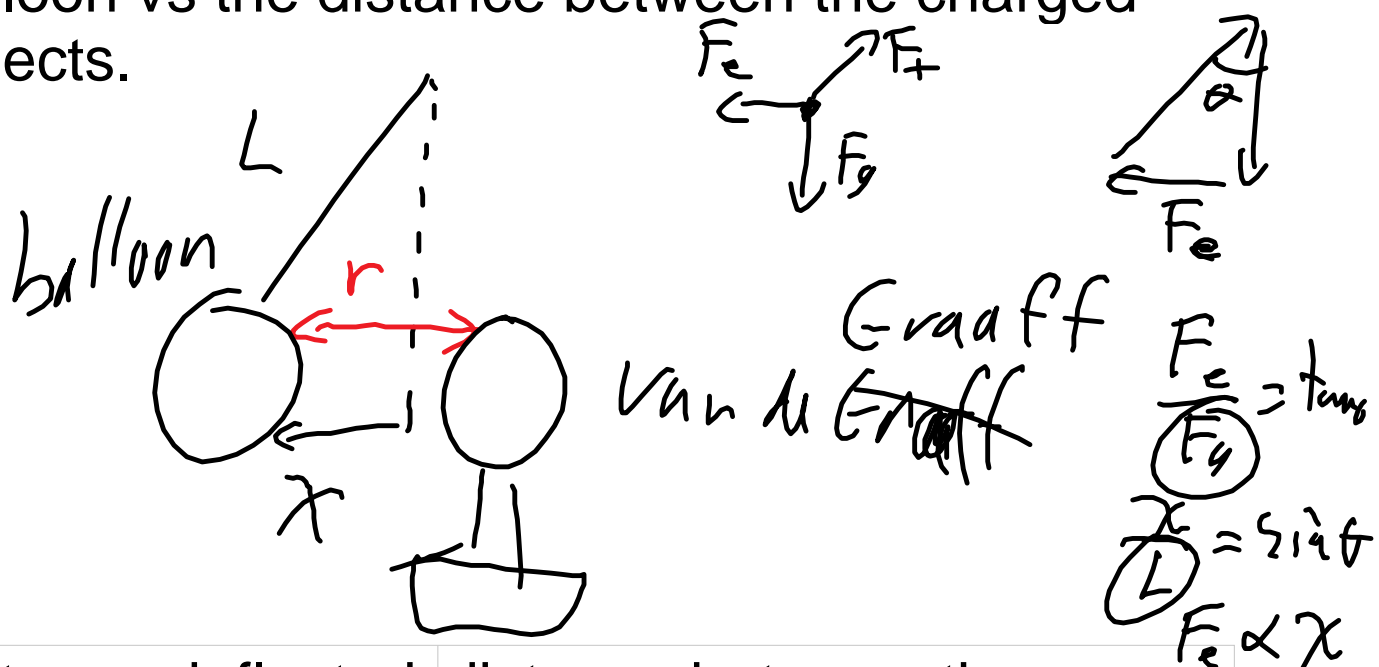
there are 3 types of charge: positive (proton, up quark, positrons) negative (electrons, muons, down quarks) neutral - fundamental neutral (neutrinos and anti-neutrinos, photons, gravitons? WIMPs? -dark matter?) and composite neutral (the wall - so why does the wall attract Marco's balloon - charge on the balloon induces a dipole moment - like charge goes away, opposite goes closer there is a net force of attraction so that means that closer charges result in stronger force.)

Like charges repel, opposites attract
composite neutrals can attract
fundamental neutrals don't interact with charge

Demo - Lab

Van de Graaff Generator and balloon

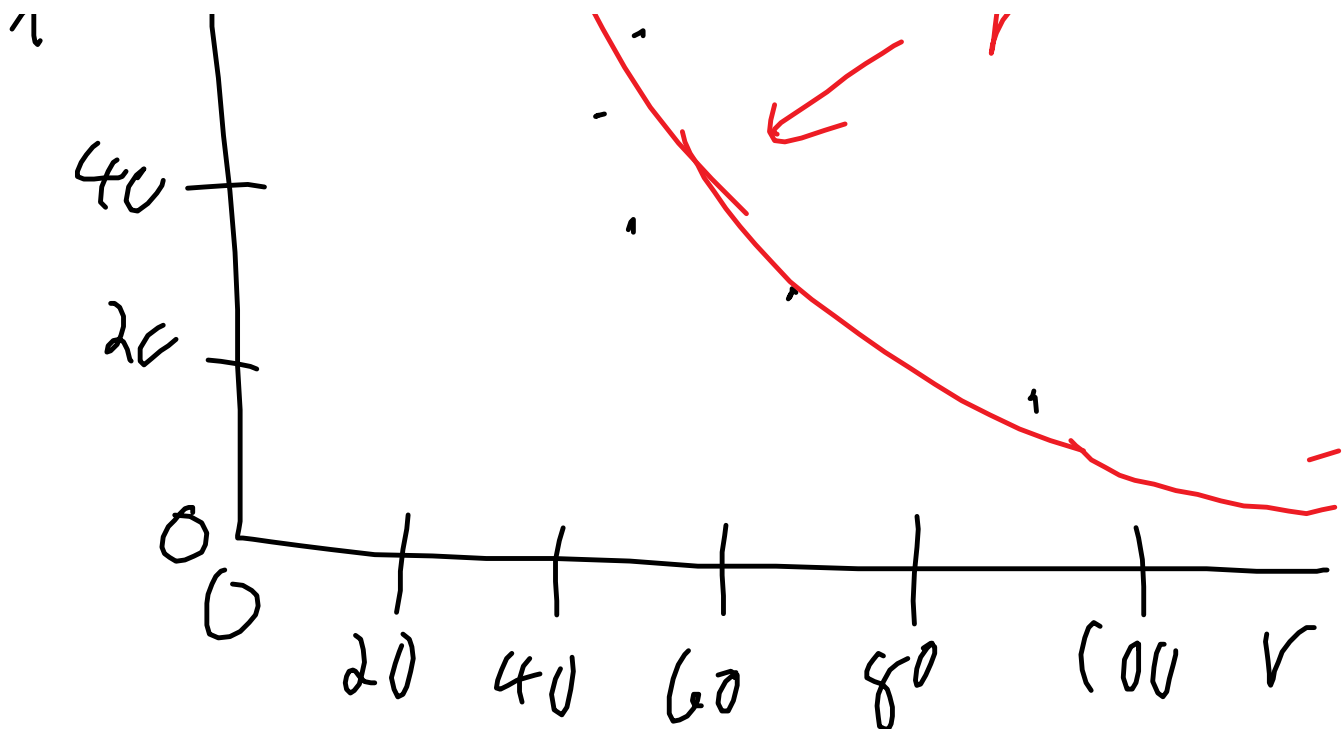
We charge both and measure the force on the balloon vs the distance between the charged objects.



distance deflected, x	distance between the charges, r
47cm	53
33	53
25	70
17	90
42	48
63	48
74	35

$F \propto \frac{1}{r^2}$
 $F \propto \chi$

$\frac{1}{r^2} \propto F_e$



So, the electrostatic force decreases with distance, if you use your imagination we can guestimate

$$F_e \propto 1/r^2 \quad (\text{hey, like gravity})$$

What other factors influence the force?

How much charge, q and Q .

$$F_e = kQq/r^2 \quad \text{Coulomb's Law}$$

k is electrostatic constant = $8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$

(heads up, $k = 1/(4\pi\epsilon_0)$ where ϵ_0 is the permittivity of free space - use it for capacitors and $c = 1/\sqrt{(\text{permittivity} \times \text{permeability}(\text{magnet}))}$)

eg. An electron orbits the proton in a Hydrogen atom a distance 0.50 \AA (ångström) = $5.0 \times 10^{-11} \text{ m}$ away.

- a) what is the electrostatic force between the electron and proton?
- b) imagine the electron moving in circular motion. What is the velocity and period of the orbit?

Questions are due Friday

p436 Q1-7,

p437 Q1-13 odds